ENGINEERING NEWS.

Tribune Building, New York City.

GEO. H. FROST, PROPRIETOR.

SATURDAY, OCT. 15, 1881.

THE AMERICAN INSTITUTE SEMI-CENTENNIAL EXHIBITION.

Last year we gave a brief history of the Institute and of the work it had accomplished. This year we propose to confine our remarks to exhibits not previously mentioned.

THE BRUSH ELECTRIC LIGHT.

In summing up the most difficult problems in electric lighting, the *Scientific American* of April 20, 1881, enumerates as follows:

"(1) To provide an efficient and economical means of converting mechanical power into electric energy, that is, a good dynamo-electric machine. (2) To devise a generator able to evolve an electric current capable of subdivision, to supply a series of lamps in one circuit. (3) To invent a self-regulating lamp adapted to such an electric circuit, and so constructed that any accidental disturbance of it, or its extinction, would have no effect upon the other lamps in the same circuit. The lamp to be at the same time easy to keep in order, durable and economical in power. (4) To discover an automatic method of regulating the supply of electricity so that the current would be always exactly equal to the varying requirements of the circuit."

In a monograph by Mr. Brush is a full description of his entire system, from this we make the following abstract:

"The most important peculiarities of the dynamo-electric machine are embodied in the armature, the arrangement of the field magnets and the commutator. The armature is a flat ring of soft cast-iron, which revolves in its own plane, and is composed of two or more parts, each provided with a series of grooves, and insulated from each other in such a manner as to prevent the induction of currents in the iron itself while being revolved in a magnetic field. There are wound on this ring eight bobbins of armature conductor, whose planes radiate from the axis of rotation. The field magnets face both sides of the armature, in the plane of its rotation, and by this arrangement both sides of the flat bobbins are exposed to the inductive influence of the magnets.

"Field magnets of opposite polarity are applied to diametrically opposite points of the annular armature, which then consists practically of two semi-circular magnets, having their like poles joined. Each of these semi-circular armature magnets, if straightened out, would be much longer than its own diameter, and would have its bobbins wound at right angles to its axis, and covering the greater part of its length. Now, it will be evident, that with a given length and weight of armature conductor, a very much greater number of convolutions may be formed on such an armature than would be possible on other armatures whose length from pole to pole is short compared with their diameter. But inasmuch as the field magnets are applied to both sides and very nearly the whole length of the long armature, the magnetic field in which the bobbins of conductor move, is quite as intense as that obtainable when any other form of armature is employed, and perhaps more so; hence, the electromotive force of current obtainable with an armature conductor of given resistance is, *certeris paribus*, very much greater with this form of armature than with any other. The bobbins of wire on the armature are not connected together, but only each pair diametrically opposite. The two free ends of the conductor thus formed are carried to diametrically opposite segments of the commutator—these segments being attached to no other bobbins. Each pair is absolutely independent of any other pair.

"The commutator consists of four separate rings of metal, each ring consisting of two nearly semi-circular segments, whose ends, on one side, are separated by a considerable space. This space is occupied by a piece of metal attached to an adjoining ring, and known as an 'insulator.' It is insulated by an air space from each of the segments between whose ends it is located, the other ends of the segments being simply separated by a single air space. The office of the 'insulator' is to separate either of the brushes which collects the currents from the commutator, from both segments during a certain interval, and twice in each revolution of the commutator. During these separations, the two bobbins of wire on the armature which are connected with the pair of segments are not only out of the general circuit, but are often circuited themselves, so that no current can circulate in them.

"Each pair of bobbins on the armature is thus provided with a commutator ring, and the segments of this ring occupy the same angular position with regard to other segments that its bobbins occupy with regard to bobbins attached to the said other segments.

"It will now be seen that only one pair of armature bobbins is out of the general circuit at one time, and this is made to occur when the said bobbins are at and near the neutral points of the armature, and are not in a condition to contribute to the general current. Now, if it were not for the 'insulators' above described, the idle bobbins would afford an easy passage for the current from the active bobbins, and thus destroy the efficiency of the apparatus." Mr. Brush follows with a comparison between his own and the Gramme commutator.

THE LAMPS.

The peculiar features of the lamps are fully described as follows: "These are, very great simplicity of construction, insuring ease of management, safety against internal derangement and securing great regularity of working; the double magnet circuit conveying currents of opposite direction, by means of which any number of lamps may be operated in a single circuit without any irregularity of action; the short circuiting safety attachment, by which any lamp offering an abnormally great resistance, owing to the final consumption of its carbons or other cause, will, without any change of strength in the main current, automatically short circuit the said lamp, and thus preserve the integrity of the general circuit; the multiple sets of carbons, burning successively, without the intervention of any switching or other special mechanism, and yet securing the maintenance of the light for any desirable length of time without requiring attention; lastly, the absence of any adjustment to be made by the attendant, other than placing the carbons.

"These lamps contain no clockwork or similar mechanism of any kind. The movement of the upper carbon, actuated by gravity, is controlled by a simple annular clamp which surrounds the rod carrying the carbon. When the lamp is in operation, one side of this clamp is lifted by magnetic action. This causes it to grasp and raise the rod, and thus separate the carbons. As the carbons burn away the magnetic action diminishes, and the clamps and rod move gradually downward, maintaining only a proper separation of the carbons. But when the tilted annular clamp finally touches the supporting floor from which it started, any further downward movement will at once release the rod and allow it to slide through the clamp until the latter is again brought into action by the increased magnetism due to the shortened arc between the carbon. In continued operation the normal position of the clamp is in contact with its lower support, the office of the controlling magnet being to regulate the sliding rod through it. If, however, the rod accidentally slides too far, it will instantly and automatically be raised again, as at first, and the carbon points thus maintained in proper relation to each other.

"Each magnet helix is first wound with a few layers of coarse wire, through which the main portion of the current operating the lamp passes. Over this coarse wire is wound a very much greater length of fine wire, having its ends connected with the terminals of the lamp, but in such a manner that the electric current shall pass through it in a direction opposite to that in the coarse-wire helix. Thus the fine wire forms a secondary current of high resistance through the lamp, which circuit is independent of the arc between the carbons, and is always closed. It follows, from the difference in direction of the current in the two helices, that the fine-wire helix will constantly tend to neutralize the magnetism produced by the coarse-wire or principal helix. The number of convolutions of the fine-wire helix and its resistance are so proportional to the number of convolutions in the principal helix and its resistance, together with that of the normal voltaic arc, that the magnetizing power of the latter shall be much greater than that of the former. Notwithstanding the small amount of current which passes through the fine-wire helix (about one per cent. of the whole current) its magnetic power is very considerable, owing to its great number of convolutions.

"Now, when a number of regulators provided with these double helices are operated in a single circuit, great uniformity of action will be maintained, owing to the peculiar function of the recording helix. Thus, when any lamp gains more than its normal arc, the resistance of its main circuit is thereby increased, more current is consequently shunted through its secondary helix, and the resultant magnetism is diminished, allowing the carbons to approach. On the other hand, if an arc becomes too short, its resistance is reduced and less current is shunted through the corresponding secondary helix; consequently the working magnetism in that lamp is increased, and its carbons are drawn further apart. Thus it will be seen that, although the general strength of the current operating a large number of these lamps does not vary, each lamp performs its regulating functions through the agency of varying magnetism precisely as though it were the only lamp being operated. * * *

"The shunting or short-circuiting device in each lamp consists of a small magnet core surrounded by a coarse and fine-wire helix similar to those of the working magnet. No current passes through the coarse wire until the magnet which it surrounds has raised its armature. The latter, together with the coarse wire, then form a part of the short circuit established through the lamp. The fine-wire helix of the shunt is put in the circuit of the fine-wire regulating helices before described. During the normal operation of the lamp this fine-wire helix exercises a magnetizing influence on its inclosed core, which thus attracts its armature with a certain degree of force, but not enough to lift it. But when, through the exhaustion of the carbons in the lamp, or from their failing properly to feed together, the arc between them becomes considerably lengthened, thus developing an abnormally great resistance in the lamp, a greatly increased current will be shunted through the fine-wire helix. The iron core of the latter will raise its armature and thus establish a circuit of low resistance through the lamp, independent of its carbons. Evidently, when the short circuit is closed as above, very little current circulates in the fine-

wire helix, and the magnet would drop its armature and thus open the circuit were the armature not retained by some means other than the magnetism due to this helix; but it will be remembered that the coarse-wire helix surrounding the same iron core is now brought into action, and by this means the armature is retained."

The carbons employed in the lamps are twelve inches long and covered with a thin layer of copper. They will burn for about eight hours, during which time nine and one-half inches of the positive are consumed and four inches of the negative.

The entire building of the Institute is lighted by six of the Brush dynamo-electric machines. The driving power is furnished by an engine of the Buckeye pattern, built by the Hartford Engineering Co., of Hartford, Conn. The cylinders are 12 in. in diameter; stroke, 21 in.; fly-wheel, 7 ft. in diameter and 21-in. face. At 130 revolutions the horse-power is 75.

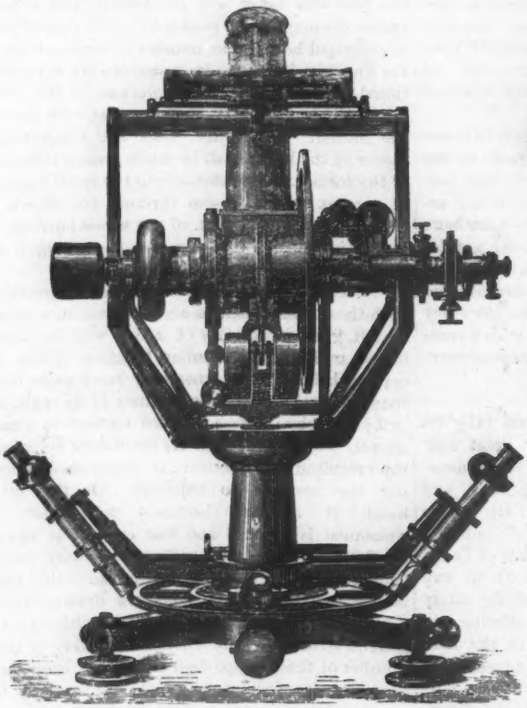

FIG 1.

ITALIAN ENGINEERING INSTRUMENTS AT THE MILAN EXHIBITION.

The cuts represent some engineering and astronomical implements which were exhibited at the recent exhibition in Milan, and which were manufactured by an engineer of that city. Such makers as Reichenbach in Germany, and Gambey in France, have been hitherto almost alone in their reputation for instruments of delicate accuracy.

Fig. No. 1 represents a large universal instrument which was constructed for the geodetical department of the University of Naples. The great feature of the machine is its accuracy in measuring angles.

Fig. 2 represents a kind of thedolite, invented by Professor Porro. All the operations of geodesy can be performed with it, and greater facilities are afforded for the use of logarithm tables. The verniers are divided into 4,000 parts. Owing to some peculiar advantages which it has, it is thought the instrument will come into very general use.

Fig. 3 is a smaller model of the same model in which the verniers are divided into 2,000 parts.

FIG. 2.

FIG. 3.

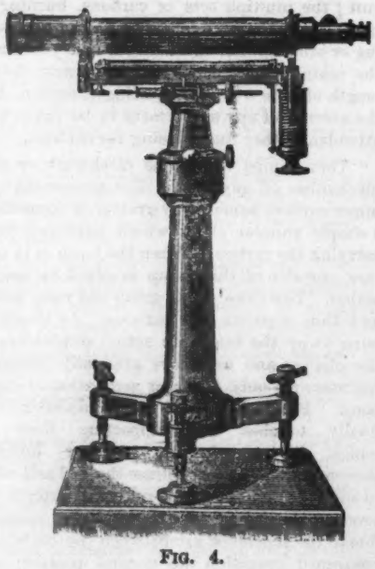

FIG. 4.

The larger model is, however, of immense service in mapping. The telemeter, Fig. 4, is, as its name indicates, for measuring distances, and will doubtless be appreciated more by military engineers and artillery officers than by any other class. Precision of firing at the immense range of modern artillery is dependent on accurate knowledge of the angle of vision and the altitude of the station. It has been adopted by the Italian Ministers of War and Marine.

PERSONAL.

Mr. E. J. Ward, Asst. Eng. C. & A. R. R., and Miss Anne R. Vaughan, daughter of Dr. J. P. Vaughan, were united in marriage on Wednesday afternoon, Oct. 5, at the residence of the bride's parents, at Glasgow, Mo.

Chas. A. Sweet, C. E., of the Mexican Central Railway, has completed his reconnoisance of the route—over 1,000 miles—from the Rio Grande at Eagle Pass to Durango, and from Chihuahua to Leon. The last-named place will be his headquarters for several months to come.

W. R. Freeman, Hydraulic Engineer, who was Constructing Engineer for the water-works at San Antonio and Austin, Texas, has been visiting in this city during the past two weeks.

A. A. Robinson has returned from New Mexico to Topeka, where he will remain as Chief Engineer of the A., T. & S. F. R. R.

George B. Lake goes to Arizona to take charge of construction of the Sonora Branch.

F. Leach, Jr., and T. Seely are appointed Superintendents of divisions in New Mexico.

C. C. Chandler has accepted an offer of Chief Engineer of the K. C., St. J. & C. B. R. R.

Thomas Evershed, of Orleans, N. Y., is the Democratic candidate for State Engineer. He is considered a very capable civil engineer.

Lieutenant-Commander Henry A. Gorringe, who brought Cleopatra's Needle across the Atlantic, is a member of President Villard's excursion party to the western terminus of the Northern Pacific road.

Col. E. B. Armstrong, aged seventy-two years, President of the Merchant Iron Mill in Rome, N. Y., died in that city this week. He was largely interested in the iron business at Rome and Taberg, and was President of the Rome Gas-Light Company for twenty-eight years.

The position of General Superintendent of the Lake Shore & Michigan Southern Railway, recently made vacant by the resignation of Charles Paine, has been tendered to James T. Furber, General Superintendent of the Boston & Maine Railroad. It is reported here that Mr. Furber has signified his acceptance of the offer.

Mr. S. Van Cleve, who for the past nine years has held the position of Superintendent of the Water-Works of Des Moines, Ia., has resigned. Under his direction all fires have been quickly extinguished, and the flow of water through the mains has never ceased, except in two or three instances, when the suction pipe was being repaired or extended. In all his work he has been eminently successful, giving perfect satisfaction both to the public and the company.

The Mississippi River Improvement Convention, to be held in St. Louis, commencing Wednesday, Oct. 26, and continuing three days, will be of considerable magnitude, as least so far as the number of delegates is concerned. At the lowest estimate 1,500 gentlemen will contribute their intelligence and experience concerning transportation, to render the resolutions adopted at the convention the outspoken expression of the people. A banquet is to be served at the Southern Hotel, where plates will be set for 2,500 ladies and gentlemen. An army of 400 waiters will dance attendance on the

pilgrims, and the menu will be an artistic triumph for the caterer, who will be accorded carte blanche for the occasion.

Gen. Silas Seymour, the Republican candidate for New York State Engineer, is fifty-five years of age. He held the office of State Engineer and Surveyor in 1855 and 1856. He is best known from his connection with engineering works throughout the country. For sixteen years he was assistant engineer of the Erie Railway, and for many years was consulting engineer of the Union Pacific road. He has also been identified with the construction and equipment of the Lexington & Nashville, Mississippi & Ohio, Sacramento Valley and other roads. He was chief engineer and general superintendent of the Buffalo and New York City Railroad. He was awarded much praise for his work in constructing the Portage Bridge.

There is talk among army officers of the appointment of General Cyrus H. Comstock, of the Engineer Corps, to the Superintendency of the Coast and Geodetic Survey, vacated recently by the death of Captain Carlile Patterson. General Comstock is stationed at Detroit. The geodetic survey of the lakes has just been completed under his directions. His attainments have been recognized abroad as well as here, and on all sides the appointment is spoken of as one that would be eminently fitting. There is no movement in General Comstock's behalf by his friends, except perhaps an occasional individual recommendation, and he has no idea yet that he is thought of in connection with the place.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 407.)

CVIII.—AUBURN.

Auburn, New York, in lat. 42° 55′ N., long. 76° 36′ W., is on the outlet of Owasco Lake, which flows through the city and furnishes a valuable water power.

The city is built on high, uneven ground.

First settled in 1793 it was incorporated as a city in 1848.

In 1864, the population being about 14,000, waterworks were constructed by a private stock company, taking water from the outlet of Owasco Lake, which is 12 miles long and 1 mile in average width, and has an area of 7,400 acres. It is surrounded by slaty hills, and the area of its watershed including the lake is 156 square miles.

Water is impounded by a masonry dam 14 ft. high, one mile from the centre of the city, built jointly by the water company and the State of New York, the outlet being used when necessary as a feeder to the Erie Canal.

Water is pumped directly into the distribution mains by Holly pumps driven by three turbine wheels of 7, 5½ and 5 ft. diameter, and a reserve 200 horse-power steam engine. Domestic pressure of 50 lbs. and fire pressure of from 80 to 100 lbs. are maintained. The 5-ft. turbine drives a gang of six vertical pumps of 14-in. diameter and 12-in. stroke, with a capacity of 1,500,000 gallons in 24 hours.

Formerly there were two rotary pumps driven by two turbine wheels, all of which have been removed.

The 7 and 5½-ft. turbines now drive one 4-cylinder pump of 14-in. diameter and 17-in. stroke, with a capacity at 30 revolutions of 6,000,000 gallons in 24 hours, and two rotary pumps of 2,000,000 gallons capacity each.

The reserve steam engine is of the Holly pattern with 4 cylinders of 12-in. diameter and 24-in. stroke, and is geared to run any or all of the pumps.

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The two larger turbines are also geared thus, and the steam and water power can be combined.

The water power is much less than formerly, and the pumping is done by steam for three to six months of the year.

Distribution was at first partly by cast-iron and partly by wrought-iron and cement pipes. In 1875 cast-iron began to be substituted for wrought-iron and cement, and now most of the cement pipe has been replaced by iron.

In 1880 there were 26 miles in use, of from 12 to 4-in. diameter, 10 miles being less than 6 in. in diameter, with 253 hydrants and 200 taps. The city pays for each hydrant $68.50 per annum.

During the present year the use of meters has been introduced in livery stables, breweries, and all manufacturing establishments.

In 1881 the population was 21,924 and the daily average consumption 2,600,000 gallons.

The cost of works and additions has been about $300,000. No statement of receipts and expenditures is furnished.

The works are managed by an executive committee of three.

The engineers and superintendents have been A. H. Goss, J. Lewis Grant, and Nelson B. Eldred, who is now superintendent and treasurer.

The president of the company is A. G. Beardsley.

CIX.—STILLWATER.

Stillwater, Minnesota, is in lat. 45° 2′ N., long. 92°, 45′ W., at the head of Lake St. Croix, on a small plain, surrounded by hills, which rise to an elevation of about 280 ft. above the valley.

The town was settled in 1842, and incorporated as a city in 1854.

Water-works were built by a private company in 1880, taking water from McKusick's Lake, about a mile from the centre of the city, and 159 ft. above the plain. The lake covers 55 acres, is from 6 to 10 ft. deep, and has a water-shed of about 6 square miles. A filter pit 100 by 50 ft., and 10 ft. deep, filled with gravel and charcoal over 2 by 4 inch strips of plank set on edge, receives the water from the lake. From the filter it passes into a reservoir 100 by 200 ft. by 10 ft. deep, whence a 24-in. earthenware pipe conducts it to the pumpwell, 12 by 6 ft., and 12 ft. deep.

Two Blake pumps with 20-in. steam and 11-in. water cylinders, copper-lined, of 24-in. stroke, force the water into the mains. At Third and Myrtle streets, about a mile from the pumps, a 10 in. check-valve and 12-in. regulator, made by H. Mueller & Co., divide the high and low services. Two high-service pipes lead to the hills on the north and south, on each of which is a tank of plate iron 30 ft. in diameter and 20 ft. high. The regulator is 120 ft. below the pumping station and 240 ft. below the tanks, and about a mile distant from each.

It is intended to supply the lower service by gravity, using the pumping machinery only for the high service and fire protection. Distribution is by cast-iron pipe, of which 7.5 miles are laid, with 87 fire-hydrants and 139 taps. Meters have not been used.

The works have been in operation since December, 1880. The population in 1880 was 9,054. The daily consumption is 1,500,000 gallons. This large consumption is owing chiefly to the use of water for excavating sand to fill low ground. Several motors are in use to drive printing presses and other machinery.

The cost of maintenance to Oct. 1, 1881, was $2,430. The receipts from water rents had been $3,642. The city is to pay $7,000 per year for fire hydrants and the use of the water for the public buildings and free drinking fountains.

The cost of the works has been $200,000. The capital stock of the company is $100,000. Walter H. Sears, C. E., was the engineer of construction. The pumping machinery was built after the designs of H. H. Harrison, M. E., who is the superintendent. H. W. Cannon is the secretary and treasurer.

CX.—JACKSONVILLE.

Jacksonville, Florida, is situated on the west bank of the St. Johns River, 25 miles from its mouth, in lat. 30° 20′ N., long. 81° 40′ W. The elevation of the city above tide-water varies from 5 to 33 ft. It was incorporated in 1857. In 1879–80, water works were built by the city, after the plans and under the superintendence of R. N. Ellis, C. E. Water is taken from a well 50 ft. in diameter and 31 ft. in depth, with walls of brick laid in Portland cement, which was sunk through sand 20 ft. to rock and into the rock 11 ft., intercepting several large streams of water in the rock, which supply 1,200,000 gallons in 24 hours. The well is covered with a slate roof.

Water is pumped into the mains by a Worthington duplex compound condensing engine of 1½ millions capacity in 24 hours. There is also a Worthington duplex non-condensing engine of the same capacity for reserve. Steam is furnished by two return tubular boilers, 5 ft. in diameter and 17 ft. 1 in. in length, built of steel; each boiler is large enough to run both pumps.

A small stand-pipe gives the ordinary service pressure, 40 lbs., which is shut off in case of fire, and the pressure raised to what is needed; ordinarily 75 lbs. are sufficient. Ten fine streams have been thrown at the same time to a height of 120 ft. with a pressure of 120 lbs.

The distribution is by cast-iron pipe. Eight miles have been laid from 14 to 6 in. in diameter. The connections to fire hydrants are all 6-in. There are 100 fire hydrants set and 50 stop gates. There are 200 taps in use, with 156 meters.

The population in 1880 was 8,000. The consumption is not stated. The cost of the works was $98,000. The works are managed by the trustees of the Sanitary Improvements Bonds. R. N. Ellis is the superintendent.

CXI.—JACKSONVILLE, ILL.

Jacksonville, Illinois, in lat. 39° 45′ N., long. 90° 18′ W., is on Mauvaisterre Creek.

In 1873, the population being about 8,000, waterworks were built by the city, after the plans of E. S. Chesbrough, C. E., and under superintendence of E. Wolcott.

The supply is obtained by impounding the surface drainage in a prairie ravine by an earthen dam 18 ft. high. The drainage area is about 4 sq. miles of rolling prairie under cultivation. The site was excavated, and the reservoir, when full, is in no place less than 12 ft. deep. The reservoir has a capacity of 60,000,000 gallons.

Two direct-acting pumps built by Chas. B. Hardwick, one with steam cylinder of 26-in., water cylinder of 14-in. diameter, and 36-in. stroke, the other with steam cylinder of 26-in., water cylinder of 14-in. diameter, and 22-in. stroke, lift the water 133 ft. into the distributing reservoir which has a capacity of 2½ million gallons. It is 86 ft. above the city, circular, with earth embankments, and has inner slopes and bottom lined with clay and paved with brick.

The distribution is by cast-iron pipe. In 1878 there were 9 miles laid, of which 3 miles were less than 6 in. in diameter, with 70 fire hydrants and 200 taps.

The population in 1880 was 10,929. The daily consumption in 1876 was 225,000 gallons.

The works had cost, to 1876, $159,000 and the yearly cost of maintenance was about $3,500.

The works are managed by the city authorities. E. Wolcott had been superintendent from the beginning to 1876.

CXII.—PITTSFIELD.

Pittsfield, Massachusetts, in lat. 42° 26′ N., long. 73° 18′ W., is situated in an elevated valley. It was incorporated as a town in 1761.

In 1854 water-works were built by the town after the plans and under the superintendence of Phineas Ball, C. E., taking water from Ashley Pond and Ashley Brook, and Sackett's Brook, two sources of supply, and conveying it by gravity to two distributing reservoirs.

Ashley Pond has an area of 80 acres. The conduits are of cast iron, 10 and 12 in. diameter. The distributing reservoirs have a capacity of 1,000,000 gallons each. They are built of earth and stone. The respective elevations are 128 and 140 feet above the town.

Distribution was originally of wrought-iron and cement pipe, now replaced by cast-iron pipe. In 1878 there were 30 miles laid, with 70 fire hydrants. The number of taps in 1876 was 1,800.

The population in 1880 was 13,367. The daily average consumption in 1876 was 1,500,000 gallons.

The works cost to 1876 $195,000, and the yearly cost of maintenance was $1,800.

The works are managed by a board of water commissioners. R. A. Dunbar was superintendent to 1878. Later information has not been furnished.

CXIII.—MUSCATINE.

Muscatine, Iowa, on the Mississippi River, in lat. 41° 26′ N., long. 91° W., is built on a rocky bluff. It was first settled in 1836, and incorporated as a city in 1853.

In 1875–76, the population being 7,537, water-works were built by a private company after plans and under superintendence of W. C. Weir, taking water from the Mississippi River through a gravel filter 15 ft. square.

Two direct-acting plunger pumps, built by Cope & Maxwell, with steam cylinders of 16-in. diameter and water plungers of 10-in. diameter, with stroke of 30 in., the joint capacity being 1,500,000 gallons in 24 hours, lift the water from the river to the reservior, which is 172 ft. above high-water mark in the river, and furnishes the domestic supply, while fire pressure is obtained by direct pumping.

The distributing reservoir, which has a capacity of 1,000,000 gallons, is rectangular, in excavation and embankment, 16 ft. deep, has inner slopes of 1½ to 1 covered with puddle, and is lined with brick laid in cement.

Distribution is by cast-iron pipe. In 1878 3.5 miles had been laid, of which 250 ft. were less than 6 in. in diameter, with 40 fire hydrants.

The population in 1880 was 8,294. The cost to 1876 was $39,500. The consumption, revenue and expenses are not known. The works are managed by a private stock company. J. F. Gurluy was superintendent in 1876 and William Molis in 1878.

CXIV.—RAHWAY.

Rahway, New Jersey, in lat. 40° 38′ N., long. 74° 17′ W., is on the Rahway River at head of tide, 5 miles from its mouth, on Staten Island Sound. Settled in 1720, it was incorporated as a city in 1858.

In 1871 water-works were built by the city after the plans and under the superintendence of George H. Bailey, C. E., taking water from the Rahway River, and pumping it directly into the mains by a Worthington pumping engine of 1,500,000 gallons capacity.

Distribution is by wrought-iron and cement pipes, of which there were 9 miles laid in 1878, with 125 fire hydrants.

The population in 1880 was 6,430. The works cost to 1876 $185,000. The works are mahaged by a board of water commissioners. James M. Silvers was superintendent in 1878. Later information has not been furnished.

CXV.—TIOGA.

Tioga, Pennsylvania, is in lat. 41° 54′ N., long. 77° 12′ W.

In 1874 water-works were built as a private enterprise by, after plans and under superintendence of, C. H. Wickham, C. E., and A. F. Wickham, taking water from Beatty Creek, the watershed of which is 9 sq. miles.

Water is impounded by a timber dam thrown across the stream, forming a reservoir of 3,000,000 gallons capacity, and is filtered through a sand and charcoal filter in a wooden crib. The conduit is of 6-in. banded wooden pipe.

The distributing reservoir is 100 ft. square at the top and 80 ft. square at the bottom, and 15 ft. deep. Its capacity is 750,000 gallons. Distribution is by banded wooden pipe. In 1877 3 miles had been laid, of which 2 miles was of less than 6 in. in diameter, with 14 hydrants and 120 taps.

In 1877 the population was 1,000 and the daily average consumption 40,000 gallons per day. The works cost $16,000 and the yearly cost of maintenance is $250. The works are owned and managed by O. H. and F. A. Wickham.

CXVI.—MOUNT JOY.

Mount Joy, Pennsylvania, is in lat. 40° 6′ N., long. 76° 28′ W.

In 1873 water-works were built by the town, after plans and under superintendence of Henry P. M. Birkinbine, C. E., taking water from Chiquesalurga Creek, which drains a sandstone and slate formation and furnishes soft water.

Water and steam power are used to lift the water into the reservoir, which has a capacity of 500,000 gallons, and is in excavation and embankment. Direct pumping is used for fire protection.

Distribution is by cast-iron pipes, of which in 1877 37 miles were in use, with 23 fire hydrants.

The population in 1880 was 2,063.

The consumption, revenue and expenses have not been furnished.

The works to 1877 had cost $35,000.

The works are managed by the Town Council.

In 1877 William Kone was superintendent.

CXVII.—SOUTH HADLEY.

South Hadley, Massachusetts, in lat. 42° 18′ N., long. 72° 33′ W., is on the Connecticut River.

In 1872 water-works were built by the village, after plans of W. B. Harris, C. E., and under superintendence of E. C. Davis, C. E., taking water from springs on a table land 135 ft. above the Connecticut River and storing it in a reservoir of irregular form, covering 1 acre and 6 ft. deep.

The distribution is by cast-iron pipes, of which 6 miles had been laid in 1876, with 42 fire hydrants and 230 taps.

The population in 1876 was 1,500. The works had cost $54,000, and the yearly cost of maintenance was $500.

The works are managed by the fire district and a board of water commissioners, to which F. Carew was clerk in 1876.

(TO BE CONTINUED.)

We acknowledge MS. of the history of the water-works of Portland, Me., from George P. Wescott, C. E., Superintendent and General Manager.

CORRESPONDENCE.

WROUGHT-IRON SCREW BOLTS.

MILWAUKEE, Wis., Oct. 6, 1881.

EDITOR ENGINEERING NEWS:

What is the general practice in relation to the dimensions of the heads of wrought-iron screw bolts? Manufacturers in the West generally give screw bolt heads less dimensions than those given by Trautwine.

Is not the strength of heads, as given by Trautwine, page 374, very largely in excess of the strength of the bolt? Yours truly. L. Y. S.

[The practice upon the Brooklyn Bridge, as we learned through the kindness of Col. Paine, has been to follow the Franklin Institute, or Sellers' System for Screw Threads and Bolts, except when the character of the work demanded a change. The nuts have been made of softer material than the bolts and of a thickness in excess of that of Trautwine, which is equal to the diameter of the screw. The difference in quality thus enabled the nut, when subjected to steam, to conform more closely to the bolt. The nuts upon the suspender rods which support the floor-beams were made much thicker than the diameter of the screw. The head need not be so thick as the nut. The strength of the nut as given in Trautwine is a little in excess of the strength of the bolt.—ED. ENG. NEWS.]

THE NEW FRANCIS ROD.

CITY ENGINEER'S OFFICE, CITY HALL,
PROVIDENCE, R. I., Sept. 25, 1881.

EDITOR ENGINEERING NEWS:

I have noticed of late considerable interest taken in the question of new methods of marking, for self-reading leveling rods. The representations in your paper show how general is the desire to arrive at a perfect self-reader. My idea of such a rod is that the divisions should be so marked as to enable one to distinguish instantly each from its neighbor, that there should be some difference in the shape and position of the divisions to prevent monotony and error, and that each division should be so marked that one might take the reading without counting or possibility of mistake. I take

pleasure in now presenting to the public, through your paper, a rod designed by Mr. H. N. Francis, assistant engineer in this office. I present it to you, with his consent, and hope that it will so far meet your approval that it may appear in your paper. Inclosed is a section of the rod for your inspection. It may explain itself, in that it is so simple. The marking seems a complete graduation to hundredths of a foot without visual division, and can be read without counting spaces. In fact, the figures 2, 5 and 8 are made to do double duty, which I think is a valuable point, as all visual division and counting of spaces of uniform shape and size must consume time, with liability to mistake.

At all reasonable distances it is considered as reliable as the target rod, with all the advantages of a self-reader. This system could easily be adapted to the "metric system."

The marking on the rod should be black on

white, but the foot-marks could be well made red, and larger than the tenths.

Inviting criticism through your paper, I remain your obedient servant,

WILLIAM HARRIS,
Assistant Engineer, City Hall, Providence.

ERRATA IN SHREVE'S "BRIDGES AND ROOFS."

IOWA STATE AGRICULTURAL COLLEGE,
AMES, Ia., Sept. 21, 1881.

EDITOR ENGINEERING NEWS: The following are errata in Shreve's "Bridges and Roofs." I should like the opinions of those who have examined this

ERRATA—SHREVE'S BRIDGES AND ROOFS.

Page	Line.	From.	For.	Read.
50..	Fig. 21	.....	m	n
61..	9	Top	$\frac{x}{2}+\frac{p}{2}$	$\frac{x'}{2}+\frac{p}{2}$
61..	10	Bottom	x in *Eq* (40)	x' in *Eq* (41)
61..	9	"	x' in *Eq* (41)	x in *Eq* (40)
62..	5	"	$x'-p$	$x-p$
62..	4	"	$x-p$	$x'-p$
70..	12	Top	x	x'
81..	*Eq* (63)	.....	$w'+p$	$u'+\frac{p}{2}$
87..	*Eq* (65)	.....	$-p^2$	$+3p^2$
131..	11	Top	$\frac{w}{2}+p$	$\frac{x}{2}+p$
136..	3	Bottom	*Eq* (120)	*Eq* (123)
161..	*Eq* (164)	.....	x^2	x^2
166..	*Eq* (168)	.....	$3w^2p$	$3wp^2$
171..	9	Top	$8dl$ (100)	$8dl$ (101)
177..	2	Bottom	$-\frac{wpx}{2l}$	$+\frac{wpx}{2l}$
178..	2	Top	$\left(x-\frac{p}{2}\right)$	$\left(x-\frac{p}{2}\right)$
184..	7	"	$\frac{l}{2}-u$	$\frac{l}{2}-u'$
184..	*Eq* (212)	.....	$+\frac{pw'}{2l}$	$-\frac{pw'}{2l}$
199..	.....	.....	$\frac{wl}{8h}:\frac{w}{2}::h:\frac{l}{4}$	$\frac{wl}{8h}:\frac{w}{2}::\frac{l}{4}:h$
200..	1	Top	Parallel	Perpendicular
204..	1	"	$\left(x-\frac{p}{2l}\right)$	$\left(x'-\frac{p}{2}\right)$
205..	.. ....	... ...	$d:p::$ etc.	$p:d::$ etc.
205..	*Eq* (236)	.....	$\frac{wlu}{8l^2}$	$\frac{wlu}{4l^2}$
210..	*Eq* (240)	.....	$\frac{wlx}{8dl}-\frac{wlx^2}{8dl^2}+\frac{wlpx}{8dl^2}-\frac{wlp^2}{8dl^2}$	$\frac{wlx}{8dl}-\frac{wlx^2}{32dl^2}$
215..	11	Top	Fig. (62)	Fig. (61)
215..	9	Bottom	x	x'
217..	....	.....	$\frac{wx^2}{2l}$	$\frac{wx^2}{2l}$
222..	4	Top	$H-H'$	$H-H'$
222..	4	"	$(l-u)$	$(l-u)^2$
230..	*Eq* (266)	.....	$4dlxz$	$4dlx'$
235..	2	Bottom	$H-H'$	$H-H'$
235..	2	"	wp	wp^2
247..	1	Top	*Eq* (285)	*Eq* (287)
269..	*Eq* (307)	.....	$(l-x)$	$x(l-x)$
269..	6	Bottom	wl	wp
271..	6	"	Less	Greater
275..	5	Top	wpx''	wpx'
291..	....	... .	*Eq* (330)	$H'=\frac{wx}{2y}-\frac{wx^2}{2ly}$
291..	3	. . . .	After (330) omit second x'	
291..	*Eq* (331)	.....	$\frac{wx^2}{2ly}$	$\frac{wx^2}{2ly}$
292..	*Eq* (334)	.....	$H-H'=$	$H-H'=$

excellent work as to whether these corrections are all correct or not. I use the book in my classes here, and think it a very excellent work.

C. F. MOUNT.

TO FIND TOTAL CURVATURES OF CURVES.

NORTHERN PACIFIC RAILROAD CO.,
Engineering Department,
BRAINERD, Minn., Oct. 5.

EDITOR ENGINEERING NEWS:

I send the following table of multipliers for ascertaining the total curvature for any length or degree of curve:

Min.	Min.	Min.	Min.	
1 = .01	16 = .16	31 = .31	46 = .46	1° = .6
2 = .02	17 = .17	32 = .32	47 = .47	2° = 1.2
3 = .03	18 = .18	33 = .33	48 = .48	3° = 1.8
4 = .04	19 = .19	34 = .34	49 = .49	4° = 2.4
5 = .05	20 = .20	35 = .35	50 = .50	5° = 3.0
6 = .06	21 = .21	36 = .36	51 = .51	6° = 3.6
7 = .07	22 = .22	37 = .37	52 = .52	7° = 4.2
8 = .08	23 = .23	38 = .38	53 = .53	8° = 4.8
9 = .09	24 = .24	39 = .39	54 = .54	9° = 5.4
10 = .10	25 = .25	40 = .40	55 = .55	10° = 6.0
11 = .11	26 = .26	41 = .41	56 = .56	11° = 6.6
12 = .12	27 = .27	42 = .42	57 = .57	12° = 7.2
13 = .13	28 = .28	43 = .43	58 = .58	13° = 7.8
14 = .14	29 = .29	44 = .44	59 = .59	14° = 8.4
15 = .15	30 = .30	45 = .45		15° = 9.0
				16° = 9.6
				17° = 10.2
				18° = 10.8
				19° = 11.4
				20° = 12.0

Multiply by figures opposite the degrees and minutes of curvature, and the result will be number of minutes total curvature.

Ex. 1. Required total curvature of 3° 20′ curve 1,279 ft. long.

3° = 1.8
20′ = 0.2
2.0

1,279
2.
60) 2,558′
42° 38′ total curvature.

Ex. 2. Required total curvature of 1° 43′ curve 1,139 ft. long.

1° = .6
43′ = .43
1.03

1,139
1.03
3,417
1,139
60)1,173.17
19° 33′ total curvature.

I take pleasure in sending the foregoing rule, as it is the simplest and quickest method of calculating total curvatures I have ever tried, and I have never seen the rule in any work.

C. F. HOLLINGSWORTH,
Chief Draughtsman N. P. R. R.

MICHIGAN'S GREAT CALAMITY.

The Detroit *Post and Tribune*, in an approximate computation of the losses by the recent extensive forest and farm conflagrations in Michigan, furnishes the following figures:

In Ottawa County	$829,428
In Allegan County	116,500
In Manistee County	706,600
In Huron County	553,818
In Sanilac County	140,067
Total losses	$2,345,413

The property destroyed is thus enumerated:

Dwellings	1,147
School-houses	28
Churches	8
Hotels	12
Stores and offices	130
Mills	34
Docks	20

The insurance on all this destroyed property is said to be only $623,632. Although people's hearts have generously opened toward the Michigan sufferers, their needs have by no means been met. Probably much distress is in store for them during the coming cold season.

MICHIGAN ASSOCIATION OF SURVEYORS AND CIVIL ENGINEERS.
LANSING, Mich., Oct. 11, 1881.

EDITOR ENGINEERING NEWS:

I have received to date for our Strudwick Fund: Cash from Boston, $1; T. S. Odell, New York City, $5; J. O. Palmer, Spencerport, N. Y., $1, and Geo. H. Frost, ENGINEERING NEWS, $25. Also the following within Michigan: E. F. Guild, $2; Thos. Love, $2.50; Thos. White, $1; P. T. Cook, $2; Prof. Chas. E. Greene, $2; W. Vincent, $2; J. N. Smith, $1, and J. C. Bradt, $2; in all $41.50.

I have taken measures to ascertain if there are any other surveyors burned out and helpless beyond the two I have mentioned. Our Executive Commission will meet Nov. 1 and make disposion of the contributions.

Yours truly,
J. E. SHERMAN, Secretary.

[We have also forwarded to Mr. Sherman one box of drawing instruments from A. W. Hunking, office of Locks & Canals, Lowell, Mass., and a very liberal contribution of drawing paper and other materials by Mr. E. G. Saltman, manufacturer and dealer in engineers' and surveyors' supplies, 55 Fulton street, New York. We hope to be able to report further cash contributions next week.—ED. ENG. NEWS.]

WATER SUPPLY.

KIMBALL, Bosque Co., Tex., Sept. 18.

EDITOR ENGINEERING NEWS:

I desire to learn through the NEWS if any city or town in the United States depends solely for its water supply on the rainfall of a drainage area, collected and impounded for the purpose, without the aid of springs or running streams; or if such a scheme would be practicable. Also the percentage of the annual rainfall that could be relied on under such circumstances, making the necessary allowance for filtration, evaporation, etc.

W. J. LYNCH.

COMMENTS.

[The nearest approach which we know of to a supply in the manner indicated by our correspondent is that of Paris, Illinois, described in Mr. Croes' "History and Statistics of American Water-Works," on page 333 of the issue of ENGINEERING NEWS for Aug. 20, 1881.

The attempt does not appear to have met with sufficient success in that case to warrant an universal application of the method.

In this paper will also be found an account of the water-works at Jacksonville, Illinois, which are built on the same principle. How successfully they have worked we have not been able to learn, as no reply has been made to inquiries of late.

We believe, however, that under proper conditions such a scheme could be successfully carried out. To determine whether the conditions in any case were favorable would require careful examination by an expert in water-works engineering. There are geological, chemical and climatic questions to be considered and carefully weighed, which are beyond the power of any but an expert to form a reliable judgment upon. No rule can be laid down which would be applicable to all cases. Indeed, it is more likely than not, that no two localties can present the same conditions and be judged by the same standard. To formulate the principles governing a supply obtained from the ground water, aided by such a limited area as would be tributary to an artificial reservoir in a spot where no streams or ponds were naturally formed would require a long treatise. If our correspondent knows of a locality where water is needed, such that no other mode of supply appears practicable, we would recommend him to lay the case before an expert water supply engineer, with a full statement of the topography, geology and rainfall of the district. We use the term "water supply engineer" advisedly. There are many engineers of very great ability and skill in the construction and also in the management of water-works whose judgment is at fault in the matter of selection of sources of supply. It is also true that many of those who devise schemes for supply admirably adapted to the locality, fail utterly when they attempt to manage works. The tendency of the day is toward the division of labor, and the evolution of specialists in civil engineering as well as other professions and in the mechanical arts. It is no disparagement to an engineer to say that he has not mastered all branches of the profession, but it is to the discredit of a man to attempt unaided to do work for which his previous experience has not fitted him.—EDITOR ENGINEERING NEWS.]

Articles of consolidation of the Toledo, Cincinnati & St. Louis and the Vermilion & State Line railroads were also filed. The purpose is to operate and construct a railroad extending from the dividing line between the States of Ohio and Indiana, in Adams County, to a point on the south line of Vermilion County, Illinois. The new road will be known as the Toledo, Cincinnati & St. Louis Railroad. The authorized capital stock is $4,000,000.

ENGINEERS' SOCIETIES.

AMERICAN INSTITUTE OF MINING ENGINEERS.

HARRISBURG, PA., MEETING, BEGINNING OCT. 25, 1881.

Local Committee of Arrangements.—Henry McCormick, Chairman; H. H. Campbell, S. H. Chauvenet, George S. Comstock, E. C. Felton, Harvey Fisher, A. S. McCreath, C. E. Stafford, Jones Wister, F. W. Wood, D. Watts, Secretary.

PROGRAMME.

Tuesday, Oct. 25.—8 p. m. Opening session for the reading and discussion of papers, in the hall of the Young Men's Christian Association. Addresses of welcome are expected from His Excellency, the Governor of Pennsylania, and His Honor, the Mayor of Harrisburg.

Wednesday, Oct. 26.—10 a. m. Session for the reading and discussion of papers.

In the afternoon the members are invited to visit the works of the Pennsylvania Company at Steelton.

There will be a reception tendered by the citizens of Harrisburg and their wives, to the visiting members and ladies, in the evening.

Thursday, Oct. 27.—An excursion will be made by special train on the Harrisburg & Potomac Railroad, to the hematite ore banks of the Philadelphia & Reading Coal and Iron Company, and also, by invitation of Mr. J. C. Fuller, to Pine Grove Furnace on the South Mountain Railroad.

Friday, Oct. 28.—10 a. m. and 8 p. m. Sessions for the reading and discussion of papers.

In the afternoon an excursion will be made to the Cornwall ore banks near Lebanon.

Railroad Rates.—Excursion tickets to Harrisburg will be sold on the main line of the Pennsylvania Railroad, on the United Railroads of New Jersey Division, and on the Northern Central Railroad, for 2 cents per mile, on presentation of card orders, which can only be obtained from the secretary of the Institute.

Excursion tickets to Harrisburg will be sold on the Philadelphia & Reading Railroad, and its branches, for one and a third fare, on card orders, to be obtained from the secretary of the Institute.

The Shenandoah Valley Railroad will sell special excursion tickets from Waynesboro, Va., to Harrisburg.

Hotel accommodations.—The headquarters of the Institute in Harrisburg will be at the Lochiel House, where the special rate will be $2 a day. The rate at the United States Hotel and at the Jones House will be also $2; and at the Bolton House, $1.75 a day.

Members who wish to secure rooms in advance are requested to write directly to the hotel.

It is desirable that the secretary should know as soon as possible how many members and accompanying ladies will attend the meeting.

A special programme giving the time-table of excursions, list of papers, etc., will be ready for distribution on the arrival of members in Harrisburg.

Blanks accompany this circular for the convenience of those who wish to make proposals for membership. Persons thus proposed are entitled to the same privileges as members and associates with regard to railroad rates, etc.

T. M. Drown, Secretary, Easton, Pa.
Wm. Metcalf, President, Pittsburgh, Pa.
Oct 7, 1881.

AN EXAMINATION INTO THE METHOD OF DETERMINING WIND PRESSURES.*

About two years ago the writer prepared some notes on the subject of wind pressures, which, upon consideration, he decided not to present to the society. Subsequent events have led to a modification of some of the views then held, and with these modifications they are now presented. On account of the inherent difficulties surrounding the subject, engineers have seemed to acquiesce in an empirical solution of the problem, and to decide that nothing better could be done. This is not in accordance with the spirit of investigation now extant; neither does it tend to economy or safety in construction; and it would seem that the time had come for a more thorough treatment of the matter.

In a paper by John Smeaton on the "Construction and Effect of Windmill Sails," read before the Royal Society, May 31 and June 14, 1759, he gives a table of wind pressures, which have been quoted as authority in nearly all the hand and text books published since, and which is adopted by the United States Signal Service. He prefaces it thus:

"The following table, which was communicated to be by my friend, Mr. Rouse, and which appears to have been constructed with great care, from a considerable number of facts and experiments, and which, having relation to the subject of this article, I here insert as he sent it to me, but at the same time must observe, that the evidence for those numbers where the velocity of the wind exceeds 50 miles in an hour do not seem of equal authority with those of 50 miles and under. It is also to be observed that the numbers in column 3 (giving perpendicular force on one foot area in pounds avoirdupois) are calculated according to the square of the velocity of the wind, which, in moderate velocities, from what has been before observed will hold very nearly." (In a foot-note elsewhere he explains that certain experiments by Mr. Rouse were made with windmills by a special machine constructed so as to move the wheels (or sails), as a whole, through the air, and noting the weight lifted by the wheel with varying velocities of movement. The table is, therefore, apparently based on resistance by the fluid to motion through it, and *not* on impulse or pressure from the air. Whether these experiments are the ones on which the table is based is not stated, but may be inferred, although from what follows, it would seem that the table was computed largely.)

Referring to Weisbach's Mechanic (Vol. 1, §390, ed. 1848) the formula for the pressure tending to move a prismoidal body by the force of an unlimited stream of uniform velocity in which it is immersed is

$$P = (f_1 + f_2)\frac{v^2}{2g}d.$$

Where P = pressure in pounds per unit of cross-section.
v = velocity of stream in feet per second.
f_1 = co-efficient of pressure at up stream end.
f_2 = " " " down "
d = weight of a unit of volume of the water.

He says that where the length parallel to the axis of the stream is zero (corresponding to a thin plate), Du Buat & Duchemin found that the sum of co-efficients

$$(f_1 + f_2) \text{ will} = 1\tfrac{88}{100} \text{ or } P = 1.86\frac{v^2}{64.4}d.$$

For a length of $\frac{l}{\sqrt{\text{section}}} = 1$, the coefficient $= 1.47$.
" " " $= 2$, " $= 1.35$.
" " " $= 3$, " $= 1.33$, etc.

And as the ratio increases the co-efficient continues to diminish.

Taking the case where it equals 1.86 as being nearest to the windmill sails, and substituting 0.07925 lbs. as the weight of a cubic foot of air, we have where P = pressure in lbs. avoirdupois and V = velocity in miles per hour, $P = 0.00492\,V^2$. (1.)

This equation gives results the same as those given by Rouse in the Smeaton tables.

Du Buat found that where the ratio

$$\frac{l}{\sqrt{\text{section}}} = o$$

(or the case of a thin plate moved *against* water) the co-efficient became 1.25, or the pressure is 33 per cent. less than where the water moved against the plate. This is given in article "Resistance" in Brand & Coxe Cyclopedia as 1.43. In the same article a cylinder, with hemispherical end facing the stream is said to offer only half the resistance of the same with a plain end. Also that while the impulse of the stream against a plate 1 ft. square gave the co-efficient as $1\frac{8}{10}$, a plate with one-tenth of a square foot of surface gave it as only $1\frac{4}{10}$, or nearly 20 per cent. less. Hutton's theoretical deductions, as stated by Weisbach, for a sphere moving against air give the co-efficient as increasing from 0.59 for a velocity of 1 meter to 1.10 for a velocity of 600 meters. In Hutton's mathematics the resistance to a spherical projectile at high velocities is given as 0.43 of that to a plain surface.

Of a hemisphere, convex side forward, 40 per cent.

Of a hemisphere, plane side forward, 101 per cent., etc.

In Appleton's "Cyclopedia of Applied Mechanics," 1880, is a table of pressures calculated by Mr. Alfred R. Wolff, in which account is taken of the difference in density of the air at various temperatures. At a mean it differs but slightly from Smeaton's table, and would seem to be based on the same formula.

Prof. Cleveland Abbe, in the article "Wind," in Appleton's "American Cyclopedia," Vol. 16, writes as follows:

"Maxwell (see "Proceedings of the Mathematical Society," 1870) has given theoretical formulas and curves showing the movements of particles of an incompressible fluid streaming past a moving obstacle; while Hagen (Berlin, 1872), has experimentally investigated these motions. Thiesen (Wild's "Repertorium," 1875) has made a careful study of the experiments of Hagen and Dohrandt, and established the rule that the pressure of the wind against an inclined rectangular plate is really very nearly proportional to the square of the velocity, and the cosine of the angle of incidence of the wind, while the absolute value of the normal pressure is as given by Hagen's observations. The latter physicist (Berlin, 1874) has embodied the results of very careful observations at moderate velocities in a formula, which, converted into English measures, is as follows:

$$P = (0.0028934 + 0.0001403\,p)\,SV^2. \quad (2.)$$

By introducing the term (p) Hagen has expressed the fact that the pressure depends to a considerable extent on the *shape* as well as the surface of the resisting body."

In this formula P = the total pressure in pounds avoirdupois; p = the outline or perimeter of the exposed surface in feet; V = velocity in miles per hour; S = the area in square feet. The formula applies to plain surfaces (of no considerable depth) placed normal to the incident wind, and with the density of the air corresponding to a barometic height of 29.84 in. and a temperature of 59° Fah.

The results from equations (1) and (2), together with Smeaton's and those of Hutton, are given in the table on the following page.

All are taken for one square foot of surface. It will be seen that Hagen's are about one-third less than Smeaton's, and Hutton's about midway between the two.

The diversity of views among practical men in determining the measure of surface acted upon, the probable wind to be resisted and how the wind acts are well shown by the evidence given at the inquest on the Tay bridge disaster. These differences are greater even than those in the tables.

The journal, *London Engineering*, January 2, 1880, in discussing the accident takes the lee girder as exposing one-half as much surface to the wind as the windward girder and the whole vertical surface of the train also as acted upon, and deduces according to different supposed modes of failures pressures from $23\frac{1}{2}$ to $35\frac{5}{10}$ lbs. per square foot, expressing the belief, however, that the maximum pressure did not exceed $25\frac{1}{2}$ lbs.

In subsequent numbers of *Engineering*, evidence is given as follows:

Mr. Allan Stewart placed the pressure at 75 lbs. Mr. B. Baker placed it at 15 lbs.; he had experimented on glass in frames, and anything like 40 lbs. per square foot would have destroyed the signal boxes. He had never seen a structure blown down which was capable of withstanding 20 lbs., and he looked upon that as the maximum pressure to be taken for structures of any kind. Fences capable of withstanding only 13 lbs. had withstood storms in all situations.

He states that the French engineers assume $34\frac{6}{8}$ lbs. as the greatest pressure a train can bear without overturning. One of their engineers had gone into an examination of chimneys, and had assumed an arbitrary figure of 55 lbs. as the force they had to withstand, and this figure was now taken as the pressure against bridges, etc. The same has been taken by Rankine.

Mr. Baker said that in his own work he assumes 28 lbs., and varies the *factor* of *safety* with circumstances.

Dr. Pole and Mr. Stewart estimate the pressure required to overturn the bridge with no train upon it at $37\frac{4}{10}$ lbs., and with the train, at $34\frac{1}{2}$ lbs. (also, $28\frac{1}{2}$ lbs. as needed to overturn the lightest carriage in the open, and 33 lbs. when containing 8 passengers and shielded by the bridge members).

Mr. Law places the same at $36\frac{3}{8}$ and $32\frac{2}{3}$, respectively, and that 40 lbs. were needed to overturn the lightest carriage in the train.

Prof. Airy states that during the gale of Dec. 8, 1872, the greatest velocity recorded was 57 miles per hour, and he thought the pressure had reached 50 lbs. per foot. The maximum pressure recorded at Greenwich was 40 lbs., and then the instrument gave way.

He had estimated the pressure in the valley of the Tay at 50 to 100 lbs. "The valley runs deep, and would make a channel for the wind." He

* Read by F. Collingwood before the American Society of Civil Engineers, April 6, 1881. With discussion by William E. Worthen.

thought 120 lbs. ought to be provided for, but this would allow a large margin for safety.

He did not know whether such pressures ever obtained simultaneously over so large an area as the Tay bridge. In a letter respecting the Forth bridge, he had stated "that over very limited surfaces and for very limited times the wind pressure was sometimes known to reach 40 lbs. in England, and in Scotland would probably amount to more." The greatest that might be exerted over the whole extent of such a surface as the Tay bridge was 10 lbs.

Mr. Gilke, previous to the accident, read a paper in which he took the total surface exposed at about two-thirds of the amount assumed by *London Engineering* and the pressure needed to overturn a carriage at 39 ⅜ lbs.

Prof. Stokes, of Cambridge University, at the inquest, said he thought 10 lbs. per square foot, on a plain surface, as too low. The more rapid the *fluctuations* in the wind, the less their extent laterally. As far as experiment went the pressure was found to be nearly in proportion to the area of surface. He should like to see an exhaustive series of experiments made on large surfaces. There were difficulties in recording velocities of the wind for short spaces of time. There is a difficulty in connecting the velocities with the pressures. Hydrostatically measured, a pressure of one pound on the square foot gave a velocity of 20 miles per hour. Experiment had shown that about 20 per cent. must be added to what was called the standard pressure (that on the surface of water in a tube), in order to get the algebraic sum of pressures per foot on both sides of a plate.

Mr. Scott, Secretary of the Scottish Meteorological office, said: "The greatest velocity registered at Glasgow (during the storm which destroyed the bridge), for any continuous 60 minutes, was 71 miles; but for one 5 minutes interval, it was 96 miles; for one 3 minutes interval, 120 miles, and for three others, 110 miles per hour." The storm-gust at the Tay bridge was probably 300 ft. wide, and some gusts may be restricted to 30 or 40 ft. width.

Passing to other known disasters from wind pressure, the destruction of the Arrah road bridge across the Sone canal in India, is worthy of mention, since the weights, friction, etc., have been accurately calculated (see London *Engineering*, June 25, 1880).

This was 99 ft. long, 15 ft. wide, and continuous over two spans of 45 ft. each. It was destroyed by a very narrow belt of wind. There were no holding down bolts, and the structure was lifted and pushed bodily off the supports, with almost no injury to the masonry.

Taking the whole vertical surface of both trusses, and the wind horizontal, and assuming the friction at 50 per cent. of weight, the pressure on the supposition of the wind striking the uncompleted span first, would be 20 ⅝ lbs. If moved bodily, it must have been 39 ⅜ lbs. Calcutta was the nearest point where records were kept, and during the cyclone 50 lbs. were registered.

Coming nearer home, Mr. Francis in his report on the chimneys of the Lawrence Manufacturing Company (published in ENGINEERING NEWS, Aug. 28, 1880), states the highest recorded pressure for 50 years past on the New England coast to be 50 lbs.

Mr. C. Shaler Smith, in his paper before this Society of December 15, 1880, states pressures in the Western States at from 18 to 93 lbs., but does not state how the results were arrived at.

Mr. W. Hartnell, in a discussion in London *Engineering* of Jan. 2, 1880, states, respecting the gale in 1868, during which a momentary pressure of 80 lbs. was recorded at the Bidston Observatory in Liverpool, that on the side of the observatory farthest from the sea, the pressure was only 38 lbs. He says further, that behind a flat plate a *partial vacuum* is formed by wind rushing past the edges. One per cent. of vacuum would give an increase of pressure per foot of 21 lbs. He says that narrow, flat bars, and open structures generally, offer a *maximum* resistance per foot of area. So that a statement of so much pressure means nothing, unless we know just how it is taken. He also says that a squall in still air will travel, say 20 miles per hour, and will blow at 30 miles for a short time, thus "exerting twice the pressure that might have been expected." In other words, that the maximum pressure is twice that due to the average velocity of the wind.

It is not necessary to go farther to illustrate the conflict of opinion which surrounds every branch of this subject.

There can be no doubt that much of the uncertainty arises from the use of imperfect apparatus, the *inertia* of the parts being entirely overlooked. On this point the article "Anemometer," in the *Cyclopedia Britannica*, although written some years ago, is in a measure true now. It says: "If the currents of air were anything like uniform, it would be a comparatively simple matter to deduce the velocity from the pressure; but their variability is so great, that the relations between them become unworkably complex. We know from the elementary principles of dynamics that the pressure at any instant will vary as the square of the velocity. Obviously, therefore, the relative variations of the pressure will be *twice* as great as those of the velocity; and the *latter* are too great, as we find them to encourage us to double them artificially. It must be remembered also, that from the *inertia* of the indicating apparatus, errors will in every case arise, and *these* also will be doubled if we take the pressure instead of the velocity indications. From all this it will appear that comparatively little importance is to be attached to the earlier, and to *all* statistical anemometry."

As an example of the apparatus used for recording pressures, may be instanced that at the Central Park, in New York, as described in the report for the year ending Dec. 31, 1869. A storm occurred Dec. 18, 1869, which is fully recorded in the same report. The apparatus consists of a hollow metal cylinder 2 ft. high and 1 ft. diameter, suspended with its axis vertical by a chain, and having a chain extending from its lower end, and connecting with a spring balance. As the wind blows the cylinder to one side, the spring is extended, and a pencil attached to the spring is moved up, and records its excursion on a sheet of paper traveled slowly past it by clock work. By testing the power required to extend the spring to various points, it would seem that a fair measure of the pressure might be obtained.

On examiniug the record of the storm mentioned, however, it is seen to be a series of quick strokes outward, and back again nearly to the zero line. So much is this the case, that the paper is shaded almost black near the zero line, becoming lighter as we pass from it, and with a few detached strokes of no appreciable duration at the extreme pressures. The *greatest* pressure recorded is 22 lbs., and that only twice and at long intervals. Of 18 lbs. pressure or over, there were four at intervals of 12½, 30 and 35 minutes respectively. At 15 lbs. and over, about 10, with intervals of 2½ to 30 minutes. These are approximations, as it is difficult to measure from the lithograph.

It is evident that these records are vitiated by the *inertia* of the cylinder, just as when a pound weight is suddenly placed upon a spring balance, about two pounds will be momentarily indicated.

The instrument can in no case, however, be considered a scientific one, and there seems to be a similar difficulty with most of those employed.

Another source of error is well pointed out by Mr. Ashbel Welch, in his paper before the Society, of May 25, 1880.

If we take the fundamental formula $h = \frac{v^2}{2g}$ and calculate the pressures corresponding to air at the standard temperature and density, the results given will be very closely one-half only of those given by Rouse and Smeaton. We know, however, that the actual pressures from the wind are greater. Could each particle of air give up all its motion, and get out of the way of those to follow without affecting the latter the result would be rigorously true. There is, however, a piling up or condensation at the front or incident surface and a lateral flow—such, that the stream to be considered has virtually a larger section or base than the surface acted upon. In addition, there is the partial vacuum in the rear noted by Mr. Hartnell, but first pointed out by some of the earlier experimenters on the subject.

These results, as we have seen, are modified not only by the shape of the incident surface, but also very largely by the length of the body acted upon in the direction of the wind current.

To sum up from the data given, we find the following sources of error, if we consider the maximum pressure of the wind, upon the exposed surface of a structure, as required by the engineer in proportioning its parts:

1st. Imperfect anemometers, vitiating results by the inertia of the moving parts, thus tending to make results too large.

2d. The difficulty of translating velocities into pressures, tending to make results too *small*, since the velocity recorded is an average over a period of time, and not that at the instant of greatest pressure.

3d. The data on record are not exact. To serve the purposes of science every circumstance as to size of parts, character and shape of surface, size of openings, height above ground, and location, must be noted.

4th. Almost all the records are based upon the assumption of a horizontal wind; whereas all experience shows that this is incorrect, and that the largest possible projection is liable to be the one acted upon.

In reference to height above ground, and direction of wind, the following memoranda are to the point:

In ENGINEERING NEWS of Sept. 11, 1880, is an article referring to experiments with a specially devised anemometer, by Mr. S. Fraser, of the Scottish Meteorological Society. He says that wind currents are much modified by the ground over which they pass. For example, in front of the Royal Observatory" in Edinburgh, their deflection from the horizontal was about 45°. On the level ground it was not over 15°, except in one case near Edinburgh, when it suddenly assumed nearly a *vertical* position. In the case already mentioned of the Arrah road bridge, it would seem that there was a strong lifting, as well as a horizontal force, to have removed the bridge with so little damage to the masonry.

As to the effect of height there is in the monthly weather report of the U. S. Signal Service for September, 1880, the following quotation from a "Report on Results of Wind Observations," made with small cup and dial anemometers at different heights, by Thomas Stevenson, M. I., C. E., published in the Journal of the Scottish Meteorological Society.

"Although additional observations are much wanted at high levels, the results, so far as appears from the observations on winds varying from 2 miles an hour to 44 miles an hour, show:

1st. That spaces passed over in the same period of time by the wind increase with the height above the sea level, or above the surface of the ground.

2d. The curves traced out by those variations of velocity (from 15 ft. to 50 ft. above the surface of the ground, and possibly higher) coincide most nearly with parabolas having their vertices in a horizontal line 72 ft. below the surface.

3d. Between 15 ft. and the ground surface there is great disturbance of the currents, so that the symmetry of the curves is destroyed.

4th. The parameters of these parabolas increase directly in the ratio of the squares of the velocities of the different gales: If x be taken as the velocity of the wind at H feet above the ground the parameter of the corresponding parabola is $\left(\frac{x^2}{H+72}\right)$ and as x varies, the parameter will vary as x^2, or as the square of the velocity of the gale.

5th. In order to render wind observations comparable, all anemometers should, if possible, be placed at a uniform height above the ground, and that standard height should not be lower than 20 ft. above its surface, but, were it generally practicable, 50 ft., or a still greater height would be better.

6th. When it is desired to find for *small heights* the velocity V at any point H feet above the ground, from the known velocity v at a height h feet above the ground (h being *above* 15 ft.), the formula is

$$V = v\sqrt{\frac{H+72}{h+72}};$$

when H is above 50 ft. above ground, the V got from the formula is slightly in excess of the actual velocity. When it is wanted to ascertain the velocity for *great heights* above the sea level, the approximately correct formula, which is believed to be sufficiently correct for practical purposes, is

$$V = v\frac{H}{h}.$$

7th. It would be well for meteorologists to adopt this reduction formula and to express all wind velocities as referred to the height of 50 ft. above the ground. This formula is this case becomes

$$V = v\sqrt{\frac{122}{h+72}}."$$

It is no wonder, after what has been given, that engineers disagree as to the pressure of wind even in a given case. We find one man taking the vertical projection of one truss, another of one and a half, another of two, and so on, and almost no reference made to any other portion of the structure or to any different projection.

Again the same pressure is taken for a bridge in a clear, open space, or for a gorge where, as Mr. Cooper (Vol. IX., p. 394 of Transactions) has pointed out, there may be developed "local currents of much greater velocity" than the average of the storm.

Again, the same pressure is ordinarily taken for a short bridge as for a long one, and we have a

common agreement among observers that the violence of storms is exerted over only limited areas, and is progressive in its character. There is also the other fact that for structures of great span, the danger from repeated or "rhythmic" gusts (spoken of by Mr. Cooper) is exceedingly small. An examination of the storm record, given in the Central Park report, will show that the gusts are hardly such as to cause this danger to structures whose period of vibration is very slow.

The experiments and observations needed to secure a scientific treatment of the whole subject, and uniformity of practice among engineers, must be more exhaustive than any heretofore made; but we shall never reach the desired end by assuming that it is unreachable. In the hope that this review may assist in promoting a movement in the right direction, this paper is respectfully submitted.

P. S.—The writer would submit the following copy of a letter just received from Prof. Cleveland Abbe, of Washington, hoping that its suggestions may be favorably received by the Society.

ARMY SIGNAL OFFICE,
WASHINGTON, D. C., Feb. 8, 1881.

Mr. Collingwood, Assistant Engineer, etc.:

SIR: In reply to yours of the 5th inst., I will say that the relation between wind pressure and velocity has not as yet formed the subject of any special investigation by the officers of this office, as it is of minor importance in the study of weather and climate. But the practical importance of this subject, to engineers and others, is such, that this office has, on several occasions, considered the propriety of establishing at favorable stations, such as Cape Hatteras, and Mount Washington, apparatus for observing simultaneously both force and velocity during gales and hurricanes.

There has always existed, however, considerable diversity of opinion as to the apparatus most appropriate to this investigation, and I should be glad to receive from the Society of Engineers, or other experts, any suggestions upon this subject.

Not having access to the bulletins of your society, I can scarcely judge how far you have gone in the consideration of this very difficult subject, but I will append a list of titles of memoirs that you may find convenient to refer to.

I should be glad to obtain copies or titles of any memoirs relating to this subject which have been published in America.

Very respectfully yours, CLEVELAND ABBE.

T. R. ROBINSON.—Description of an improved Anemometer, etc. Trans. Royal Irish Academy. Vol. XXII. Dublin, 1850.

G. H. L. HAGEN.—Ueber den Widerstand der Luft gegen Planscheiben, etc. Abhandlungen d. Akad. d. Winnenschaften. Berlin, 1874. An abstract also to be found in Pogg. Annalen, Vol. 152, p. 95.

S. CAVALLERA.—Di un apparecchio per la determinazione, Sperimentale delle costanti, degli anemometri. Torino, Atti Accad. Sci., VIII. 1872–3, pp. 663–683.

F. STOW.—On large and small anemometers. Read January 17, 1872. Quarterly Journal of the Meteorological Society. April, 1872. Vol. I, pp. 41–49.

F. DOHRANDT.—Bestimmung der Anemometer Constanten. St. Petersburg, 1874, p. 60. Art. 5, Vol. IV., Wild's Repertorium.

H. THIESEN.—Zur Theorie der Wind Stärke-Tafel. St. Petersburg. 1875. Art. 9, Vol. IV. of Wild's Repertorium für Meteorologie.

H. THIESEN.—Same. Art. 11, Vol. V., of Wild's Repertorium für Meteorologie.

T. R. ROBINSON.—Proceedings Royal Irish Acad. 2d Ser., Vol. II., January, 1876, and abstract in Zeitschrift Oesterreichischen Gesellschaft für Meteorologie.

H. WILD.—Ueber den gegenwartigen Zustand der Anemometer verification. Bulletin de l'Acad. de St. Petersburg. Vol. XXIII., p. 176, December, 1876.

F. DOHRANDT.—Bestimmung der Anemometer Constanten (Fort Setzung), p. 28. St. Petersburg, 1878. Art. VI., Wild's Repertorium für Meteorologie.

WILLIAM E. WORTHEN.—I would ask Mr. Collingwood if he knows of any instrumenft by which to determine wind pressure. Some years since I had occasion for such a one, and went to Mr. James Green, the mathematical instrument maker. He showed me some, but said that they were not reliable, and that there were none manufactured that he would indorse, nor do I find since then any new form. Wind pressure is, I believe, generally estimated from velocity measures, but in pursuing my inquiry on these I consulted Charles B. Richards, one of our members, who had made experiments with two of Casella's anemometers, in his arrangements for the ventilation of the Connecticut State House; the results are published in the Journal of the Franklin Institute, May, 1875. Each instrument was tested by the maker, and a table of corrections furnished with each, and yet Mr. Richards reports that the indications of the two meters differed so widely that little confidence could be put in them. I have never been able to arrive satisfactorily at either the plus or windward pressure on a structure, or the minus or leeward. In the matter of ventilation of houses—I take it into consideration for the furnace air-ducts in the construction of chimneys—I follow examples that have stood. There is one at Hastings-on-the-Hudson, a part of the wreck of a sugar house, that ought, I think, to have blown down long ago. In "Silliman's Journal," some forty odd years since, I read of fowls being taken up in a whirlwind, and their feathers being blown out by the explosion of the air in their quills, showing that there was a considerable vacuum in the storm center. Mr. Chesbrough suggests whether there might not be a wind pressure instrument made on the principle of a pendulum, in which the force might be estimated by the amount the pendulum is swung out of plumb by it. It would seem that the list of a ship under canvas by the wind might offer some data of calculation, but they are unsatisfactory. M. Perrodil, in the "Annales des Ponts et Chaussées of 1877," gives a description of a steam gauge in which the velocity of the current is determined by the torsion of a wire. I have full drawings from him, and price.

A NOVELTY IN RAILWAY CONSTRUCTION.

The Darjeeling Tramway or Himalayan Railway is a novelty in railway construction, and will be justly regarded as one of the engineering sights of India. In his speech at the opening Sir Ashley Eden claimed for the enterprise the merit of having "solved problems never before solved in the history of railway undertakings. We know," he said, "of no other line which ascends 7,400 ft. in 50 miles, mounts gradients of 1 in 21, and comes round curves of 70 ft. radius." The line is described as presenting to the eye the appearance of a "snake winding up into the clouds." The tramway, which is 50 miles long, enables the journey from Calcutta—361 miles—to be performed in about 24 hours. Its terminus at Darjeeling is 7,690 ft. above the level of the sea. The capital of the Darjeeling Tramway Company is stated to have been raised entirely in India. The line was originally to have been completed within eighteen months, but this period has been exceeded.

The first rail was laid in May, 1879, and the contractors, Messrs. Mitchell Ramsay, succeeded in laying down the last between Jore Bungalow (7,800 ft. of elevation) and Darjeeling (about 7,400 ft.) in June last. The gauge is 2 ft. The rails are manufactured of toughened steel, and about 24,000 have been used in the construction of the entire line. Sleepers are laid at intervals of 2 ft. 8 in., extra sleepers being laid below the rail-joints; altogether above 100,000 sleepers have been used up. Bearing plates have been placed under the outer rails of all curves of 120 ft. radius and under, so as to preserve the rigidity of the outer rails. Taking the entire ascent, which commences at about the ninth mile from Silliguri beyond Lukua, at the edge of the Terai, the ruling gradient is 1 ft. in 25, but in isolated steep places the gradient is 1 in 20. From the ninth mile the line curves and recrosses the road frequently, as a rule, however, keeping to the in or hill-side of the roadway. The first distinct deviation from the ascending road occurs at a place locally known as either the Horse Shoe, the Trestle Bridge, or as Agony Point, where the line simply beetles over the edge of the *khud*, and where the trains for safety's sake slacken speed. Above Tendoria, at the nineteenth mile, the train passes through a narrow bridge and slowly describes a loop of some 640 ft. in length and then recrosses the same bridge. From the loop onward the line gradually ascends, bearing away to the right, with the *khud* below to the right of the train; while on the left rises a crumbling steep hill-side, looking very threatening, with enormous bowlders of disintegrated rock, some of which have already given much trouble to the line watchers and authorities of the company. The line doubles to the leftward near Mahanuddy and its tea-garden, and then runs parallel, but in the reverse direction, above the road which the train has just traversed. The ascent continues gradually to Kurseong, some 5,200 ft. above the sea, and thence onward past some very troublesome and equally unsafe hill-sides toward Sonada. Thence on to Jore Bungalow. From Jore Bungalow the line descends from the saddle, circling round wide deviations toward Darjeeling proper, which is reached in about seven hours, run through from Silliguri, provided no landslips or other obstacles bar the way. The engines at present used are tiny tank ones, the carriages like open tramcars of the rudest and most uncomfortable description. As regards the engines, they are just like ordinary level-line locomotives, trusting in the descent to very powerful brakes.

RICHMOND, VA., PUMPING ENGINES.

The most expensive hydraulic exhibit at the Centennial was the pumping engine furnished by Mr. Henry R. Worthington of this city, which supplied the entire exhibition grounds with water from its location on the west bank of the Schuylkill, just outside of the inclosure. The engine was of the duplex pattern, and had a capacity of 6,000,000 gallons daily. The plungers of the two horizontal, double-acting pumps were 22¼ in. in diameter; the cylinders 29 and 50¼ in. in diameter, and the stroke 4 ft. There were two single-acting air pumps, each 29¾ in. in diameter and 24-in. stroke, operated from the ends of a horizontal beam, with vertical lever attached, which received motion from one of the cross-heads. The pump was obliged to raise the water 208 ft.

At the close of the exhibition the engine was taken to the works of Mr. Worthington, in Brooklyn, where it remained until about six weeks ago, when the company received an order for it from the city of Richmond, Va., and on last Monday it was ready for steam.

The permanent pumping works of Richmond are being built on the canal near the Three-Mile Locks, which ar about three miles from the heart of the city, and will be run by water power. To keep the city supplied with water meanwhile—the old pumps being insufficient either in very high or very low water—this new steam pump was ordered. It is located on the north bank of the canal, about 150 yards below the locks.

It will require 180 horse-power to pump 6,000,000 gallons of water each 24 hours. The Erie City Iron Works furnish the four boilers. The boiler tubes are each 5 ft. in diameter and 14 ft. long, and were made within 10 days after the reception of the order. The pipes, which are to connect the steam pump with the main line (from the pump house to the new reservoir), are 24 in. in diameter and 677 ft. long, and were made and have all been delivered by R. D. Wood & Co., of Philadelphia. The water this steam pump will supply to the people of Richmond will be real river water, for it is taken up from the canal at a point only about 150 yards below where it enters into the canal from the river at Grant's dam. Right beneath the suction-pipes a brick and cement-lined well has been constructed. The bottom of the well is lower than the bottom of the canal, and a connection between the well and canal will soon be made.

The water from the pump will be forced up the hill in a diagonal line, 677 ft. to a junction with the new pump-house mains; from this point to the new reservoir the line is nearly straight. The connection pipes are 2 ft. in diameter; the main pipes 30 in. The vertical litt is about 185 ft. For the entire work the City Council appropriated $80,000.

THE STORAGE OF ELECTRICITY.*

BY SIR WILLIAM THOMSON.

The first and most obvious use of Faure's accumulator was stated by the author to be the production of electric energy at the most convenint time, and to keep it in store until it could be most conveniently used; but its largest use in electric lighting would be to allow steam or other motive power and the dynamo to work economically all day, or throughout the twenty-four hours where the circumstances were such as to render that economical, and then storing up the energy so that it might be drawn upon when the light was required. There was also a very valuable use of the accumulator in its application as an adjunct to the dynamo, in order to fulfill the first condition of giving greater regularity to the light-giving current and storing up an irregular surplus in such a manner that the stoppage of the engine would not stop the light, but only reduce it slightly, and so also that there would always be a good residue of two or three hours' supply of full lighting power after the driving machine was stopped, or a supply of light for eight or ten hours for a diminished

* Abstract of paper read in Section A, British Association meeting, York.

number of lamps. It was obvious that great economy and important practical results were to be obtained by the use of such a system, provided that the expense of the storing material and the magnitude and the bulkiness of the apparatus that it involved were not prohibitory—were not such as ran away with whatever gain there might be in the principle. The subject was altogether in its infancy, and we must wait for fuller information, both as to its practical and its economic sides. So far as estimating electrical quantities was concerned, we must hold our hands until, along with the incandescent lamps given us, there was a statement that they would continue in action, giving out so many candles' power approximately, when so many volts were applied to them, and during such and such a time.

THE BROOKLYN BRIDGE.

President Murphy, of the East River Bridge Company, speaks in vindication of those who have been charged with negligence in pushing that important structure to completion, and gives an encouraging statement respecting the progress of the work. The ex-Senator has daily inspected the structure, and had an opportunity to become thoroughly informed. He says:

The work has stopped apparently, but not in fact. The contractors are furnishing the steel as they have been doing all along. You must take into view the fact that this contract is unprecedented in its nature. There have been steel bridges of smaller dimensions, not involving any great amount of steel—among them, and the most famous of them all, the St. Louis Bridge, but the New York and Brooklyn Suspension Bridge is the greatest structure of the kind that was ever undertaken. It requires forms and shapes of steel of greater extent in themselves than ever known, calling for equipments that were not in existence in any steel works in the world. The contractors, the Edgemoor Iron Works, of Wilmington, Del., gentlemen of undoubted character, supposed, as did their competitors for the contract, that their plant, which was calculated for iron, would answer for steel, and they made their estimates accordingly. But their machinery was inadequate; it broke down, and was necessarily abandoned. The company then expended upon new machinery over $150,000—a heavy percentage on a contract for $500,000, calculated closely in competition. One of the most extensive steel manufacturers in this country says that this contract is unprecedented.

The contractors have gone on honorably with their work, notwithstanding the advance in the cost of iron, and since they have got their works in shape they have finished one-half of the whole contract, supplying the steel at the rate of between 300 and 400 tons a month. They are continuing to furnish the floor beams, which are the index to the public of the progress of the work, but not the actual index. About one-third of the floor beams are yet to be put up. They are on hand, with the exception of less than 20, and before the first of November the public will see them in place. All the floor beams will be up before cold weather comes. I have said that the work has stopped apparently, but not in fact. The contractors have been busy finishing the posts and other parts of the work, which will soon come in play immediately upon the completion of the suspension of the floor beams. We are not in so great a hurry that we can afford to have any part of this great work done improperly, and this fact is the key to certain changes that have been made involving delay. All parts of the bridge are progressing, and when the iron work is done the bridge will be done. It is the trustees' desire that in every part it shall have the imposing appearance that it presents in those parts that are nearest completion, and that the work as a whole shall be monumental.

The executive committee reported to the Bridge Company, on Oct. 3, that about 1,000 tons additional of steel would be required to strengthen the structure, so that heavy railroad cars might be run over it with absolute safety, and the board voted to advertise for proposals for supplying the same.

M. RECLUS ON THE CANAL.

M. Armand Reclus, of the Lesseps Canal Company, arrived in this city yesterday from Aspinwall, and is stopping at the Brunswick. He said last evening that he did not know when he would leave for Paris. He denies that there has been a quarrel between himself and M. Harel because the latter had entered the dining-room at the hotel in a working suit. He said that M. Harel on the third day of his arrival at Aspinwall had selected as his residence a private house, and had lived there all the time, while he (M. Reclus) had lived at the hotel. He also declared that there had been no fever on the isthmus except the swamp fever and the fever which arose while the men were becoming acclimated. He says that there had been six cases of yellow fever imported in two vessels, but that no lives had been lost from that cause, although men have been taken sick.

"Why did M. Harel go to France?" asked the reporter.

"He had three months' vacation granted him by M. Lesseps; he was not in good health."

"Why are you going to France?"

"It is in accordance with the rules of the company that I should make a yearly report."

"Why did M. Bionne go to the isthmus?"

"Because M. Bionne was M. de Lesseps' chief executive. He went there in that capacity to inspect the work of the people there, and to make a general report to M. de Lesseps."

"What was the report?"

"Mr. Richard W. Thompson has the figures. The report is on file here and at Paris."

"What has been done?"

"We have been making a general survey"—then M. Reclus corrected himself and added, "or rather a definite survey, as we say." M. Reclus said that villages of twenty houses apiece had been put up along the line of the canal, a hospital had been built at Aspinwall, and at Panama the building of the Central Hospital has been begun. They have begun to lay an underground telegraph line across the isthmus, and two excavating machines have been prepared for work. Returning to the condition of the health of the men, M. Reclus said that there had been no typhoid fever at all. The corps of physicians consists of seven eminent men, and every precaution was taken to preserve the health of the men.—*New York World, Oct. 4.*

HOW A LAND ERROR HAS BEEN PERPETUATED.

The United States Land Office makes the area of Louisiana to be 41,346 square miles. Professor Hilgard, in a census report lately published, puts the figures at 45,430 square miles. The difference is one of 2,607,300 acres. It is more than the combined area of Rhode Island and Delaware. An examination of the State by parishes show a considerable excess in land over that reported by the Land Office. There are 1,242 complete townships in the State, amounting to 44,712 square miles, besides fractions of others, showing an excess of 3,500 square miles on the lowest calculation. Professor Hilgard, of the Census Bureau, writes to the New Orleans *Democrat* that he has gone over the figures carefully with the geographer of the bureau, Mr. Gannert, and both are convinced that the Land Office report is wrong. They imagine that the first United States survey found 44,346 square miles; that the second "4" was transcribed as a "1," and that the error has been carried down from year to year, and from book to book, until the erroneous figures have found their way into all the standard authorities.

TUNNEL WORK IN THE N. P. R. R.

We have received a copy of the Helena *Daily Herald* (Montana) from J. T. Dodge, C. E., which contains an account of some of the most important tunnel work projected by the Northern Pacific Railroad. The article states that "the two most considerable tunnels projected by the Northern Pacific Railroad are within the limits of the Rocky Mountain division, about 140 miles apart. The first of these penetrates the Yellowstone range beneath the summit of Bozeman Pass, at a grade elevation of 5,589 ft. by the south prong, or 5,669 ft. by the north prong, the former in length being 3,600 ft., and the latter 1,450 ft. Of these two it remains yet to be determined which will be adopted. Next comes the tunnel of the Main range, by the Mullan Pass, which penetrates the mountain below the summit at a grade elevation of 5,548 ft., and in length is 3,850 ft. The formation at Bozeman, we understand, is essentially sandstone, while that at Mullan is mother rock. The former, for working purposes, it is estimated, will be somewhat more difficult than the granite of the latter, and under the most favorable auspices will require as much, or more, time to complete. The initial work intended to test with accuracy the quality of granite, will in a few days be commenced on the Main divide, at both ends of the located tunnel. This is a necessary preliminary before intelligent action can be taken in awarding the regular working contracts. The presumption is that the plans are carefully matured by Col. Dodge, to make such progress with the excavation as will place the workmen beyond the interferences of cold and snow before the season has advanced to the edge of winter. This applies, we believe, as well to the tunnel operations at Bozeman as here, and very shortly we may expect both of these important pieces of work will be fairly under way.

BLACK BY DAY AND WHITE AT NIGHT.

Dr. Phipson describes a gate-post that had been painted white, which appeared black all day, but white every night. This was probably due to the phosphorescence of the barium sulphide which it contained. His analysis gave the following composition:

Barium sulphate	41.50
Barium sulphide	1.02
Protoxide of iron	2.12
Oxide zinc	16.30
Sulphide zinc	37.44
Loss by calcining	1.62
	100.00

NOTES.

Medical Simplicity.

From the habit into which the surgeons fall of using technical terms in their official bulletins we feared they might obscure their report of the autopsy by the use of words not familiar to the unprofessional eye. We were pleased to find that our apprehensions had been unfounded when upon glancing at the report our eye rested upon such plain and simple words as "noecchymosis," "purpura-like spots over left scapula," which were "furfureaceous on the surface," "spineous process of the tenth dorsal vertebra," "acne pustules," "subcutaneous adipose tissue," "the greater omentum," "the posterior abdominal parietes," "the transverse colon," "pyogenic membrane," "biliary matter," "infarctions," "serous cysts," "intervertebral cartilage," "ditto foramen," "cancellated tissue much comminuted," "the cœlic axis," "the lung tissue was œdematous, but contained no abscesses or infarctions," in left lung was "a group of four minute areas of gray hepatization," "suppuration sufficiently explains aeptic conditions," etc., etc. This simple phraseology makes the report interesting to the general reader, despite the occasional and unavoidable use of words not so generally understood, as for instance, "cheesy pus," "as large as a man's fist," "blood-clot," etc., etc. The public demand for information has been fully met by the surgeons, and now they ought to take and give a rest.—*National Republican.*

The Eucalyptus Tree.

An Italian naturalist has been studying the eucalyptus tree, and finds it as valuable for destroying miasma as the most sanguine Californians have ever claimed it to be. It has extraordinary powers of absorption, the trunk of a full-grown tree taking up ten times its own weight of water from the soil in which it stands. This alone is often enough to purify a fever district, the superfluous miasma-breeding moisture in the earth being absorbed by the trees. Experiments with eucalyptus planting in miasmatic regions have given surprising results. The vicinity of the Convent Delle tre Fontane, near Rome, was one of the most pestilential spots in Italy, but monks sent there in 1868 to plant groves of these trees made it a healthful region within five years. On a farm near the Algerian borders, where previously no human being could live for any length of time, 1,300 eucalyptus plants set in 1867 have counteracted every tendency to fever. Similar experiments have been successful also in Alsace and Lorraine. The home of the tree is in Australia and Tasmania. It composes in great measure the forests of Australia. In California all varieties of the tree are to be found. It is planted there chiefly on account of its rapid growth to obtain shade and woodland on some of the otherwise treeless plains. So quickly does the eucalyptus grow, that a plant 3 ft. high set in the ground near Mentone, in 1869, had attained in 1874 a height of over 50 ft. and a diameter of 40 in. 3 ft. from the ground.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

The Goderich (Ont.) Town Council will shortly submit a by-law to the ratepayers, authorising them to

raise $50,000 for water-works purposes. Where or how the water will be obtained has not yet been determined.

KENT, O., Oct. 5.—Last night at the regular Council meeting Mr. Frost made the proposition to the Council to establish a system of water-works here for $50,000. He agreed to have the water forced from the Hawk Spring, about one mile south of town, to the top of the Presbyterian hill, on which the reservoir will be located, and from which water will be carried to the different portions of the town. The Council named Tuesday, Oct. 18, as the day for a special election to vote on a tax levy for the proposed works.

BALTIMORE, Oct. 10.—The inauguration of the new system of water supply for this city from Gunpowder River was celebrated to-day by a parade of the police, fire department and National Guard and by an illumination of Monument Square and the principal streets in the evening. The Gunpowder River works were begun in 1875 and have cost the city nearly $5,000,000. They can supply the city with 150,000,000 gallons of water daily. To-morrow evening there will be a mystic pageant by the Orioles, and on Wednesday the entertainment of the French guests of the nation will take place.

The people of the town of New Lots have determined to contest the right of the Town Board and Highway Commissioners to enter into a contract with the Long Island Water Supply Company to furnish the town with water at the rate of $15,500 a year, or more than a fourth of the entire taxable value of the town. A law was quietly put through the last Legislature enabling the Town Board and Highway Commissioners to make the contract. It is proposed by the company to supply 200 hydrants, while the people declare that 50 hydrants are amply sufficient for the town. Resolutions were passed at a mass meeting of the people denouncing the contract and the officials who made it as corrupt.

The National Meter Company, manufacturers of the Crown and Gem Water Meters, has just removed from the familiar location at 95 John street to its new and commodious offices at 51 Chambers street, four doors east of Broadway. This change, to roomier and more accessible quarters, has been effected to meet a need that the rapidly-growing business of the Company had made both urgent and desirable. The Company is energetically introducing its Crown Meter, as it is much behind on orders. Since we last visited the works of this company their floor space has been more than doubled, and additions of new and improved machinery, especially designed for their work, have been made. Their force has also been increased many times. In order to obtain brass castings of the best quality and to insure a constant supply of the same they some time since increased the capacity of their foundry; notwithstanding this they are compelled by rapid sales to have a portion cast outside.

DISUSE OF WELLS IN THE COUNTRY.—Forty years ago most of the water used for drinking and household purposes was drawn from deep wells into which it percolated through great layers of sand, beds of gravel and crevices in ledges, and in its long journey from the surface of the earth to the wells all impurities were strained out of it, so that when taken to the sink, pantry and stove it was pure. Not chemically pure, perhaps, for it was often impregnated with lime and iron and other minerals, but pure in the sense that there was nothing unhealthy about it. It is different now. The tired weaklings of this generation do not like to lift water from deep wells, and the old oaken bucket, the symbol of pure cold water, has long been part of the rubbish heap, even in the country, where the only excuse for throwing it aside is a desire to save work. In the cities other causes have helped "born weariness to abolish wells and springs, and the reliance is now almost wholly upon surface water, which will carry itself into the sinks and pantries where it is needed.—*Manchester (N. H.) Mirror.*

ELECTRICITY.

Richmond, Va., will endeavor to light its streets by electricity. Eight lights will be tried as a first experiment.

BRIDGES.

A bridge is to be erected on the line of the Bradford branch of the New York, Lake Erie & Western Railroad, across a ravine through which runs Kinzua Creek, that will be 301 ft. high and 2,250 ft. long. The structure will cost $500,000, and, says a Philadelphia paper, will be a more ticklish thing to ride over than the terrific trestles on the Catawissa Railroad.

RAILROADS.

An engineering party under J. Murray Mitchell will leave Ottawa City on Monday next for the Desert to begin the survey of the Gatineau Valley Railway.

J. M. Currier, M. P., has been chosen President of the Gatineau Valley Railway Company, vice Alonzo Wright, M. P., resigned. A vote of thanks was tendered to the latter.

The Canadian Pacific Syndicate have given a contract for all the locomotives that the Kingston Locomotive Works can build before the 1st of May next. The Syndicate's engineer, after a close inspection, has accepted the standard built by the company.

DENVER, Col., Oct. 9.—Givin & Abbott, contractors for the Denver, Western & Pacific Railroad, filed a lien for $58,478, and yesterday morning, in the District Court, at Boulder, obtained a temporary injunction against the company. The appointment of a receiver for the road is asked.

WINNIPEG, Oct. 9.—A meeting of the shareholders of the Southeastern Railway, which is to connect with the Air Line to Duluth, was held yesterday, and directors were elected. The road will be pushed forward vigorously. Next week engineers will go over the proposed route. It is not thought that many engineering difficulties will be found.

The Duchess Eugenie Litta has sold her palace for the curious reason that it is too vast to be manageable. Baron Rothschild has bought it, and will transform it into the head offices of the Upper Italian Railway. The interior decoration is magnificent; the famous Luini cartoons were bought for this palace at a price of $22,000.

The articles of association of the Richfield Springs & Cherry Valley Railroad Company were filed on Saturday last. The road is to be built from Richfield Springs to Cherry Valley, a distance of sixteen miles. The company is to continue fifty years. The capital stock is $1,000,000. Arthur Dudley Vinton, Albert M. Sabin, John Hagan and others are incorporators.

The following is a list of the directors of the South Shore Railway & Tunnel Company elected at the meeting held on Tuesday last: Louis A. Senecal, Alph. Desjardins, M. P.; A. Laberge, B. Globensky, Thomas Wilson, Gustave A. Drolet, Robert Watson, Edward Beaufort, Ed. C. Wurtele, P. S. Murphy, C. O. Perrault, F. X. Archambault, J. B. Renaud, L. A. Roberge and Joseph Simard.

A correspondent of the Philadelphia *Ledger* says that "Llanfairpwlchgobwichllandyssiliogogo," the name of a Welsh parish, is pronounced as if it were written thus: "Thlanvirepoolchgwiugergobooichthlandisiliogogo." This is important, if true. We are almost ashamed to confess we never pronounced it that way. We shall make no mistake hereafter. It is too simple a word to knowingly mispronounce.—*Norristown Herald.*

The Canada Pacific Railroad Syndicate have let the contract for sixty miles of their Sault branch to Messrs. Sullivan, Marpole & Co., of Barrie. They promise competition with the Grand Trunk; their Sault branch is part of the scheme. They express their determination to have an independent line from Toronto to Montreal by way of Perth and Smith's Falls, and the Atlantic & Northwestern have begun the inspection of the St. Lawrence at the Lachine Rapids, with the intention of building their bridge there.

J. H. Devereux, who is virtually an Erie man, recently remarked that the Chicago & Atlantic road—the Erie-Chicago line—will, when completed, be the best 260 miles of road in America. The maximum grade is twenty feet to the mile. There are but two streams of any importance to bridge over, gravel pits are convenient at several points on the line, and the work is being done in a most thorough manner. The steel rails used weigh sixty pounds to the yard, and the line is to be thickly crosstied and in every respect the construction is to be as near perfect as possible.

Articles of consolidation and incorporation of the Chicago & West Michigan, the Grand Rapids, Newaygo & Lake Shore, the Grand Haven and the Indianapolis & Michigan railroads, were filed this week. The consolidated line will be known as the Chicago & West Michigan road. The directors are: Nathaniel Thayer, H. H. Hunnewell, Charles F. Adams, Jr., Alpheus Hardy, George O. Shattuck, Charles Merriam, N. Thayer, Jr., Frank Shaw and George C. Kimball. It is the purpose of the organization to finish and operate a road from Laporte, Ind., to the city of Manistee, Mich., with a branch from Holland, Mich., to Grand Rapids, another from Muskegon to Big Rapids, another from Grand Rapids to Manistee, and still another from Holland to Battle Creek, the total length being 500 miles.

OTTAWA, Oct. 26.—The final location of the Ottawa section of the Canada Atlantic Railway is now about completed. The survey party quit work at Hurdman's Bridge last evening, and will have the line completed into the city before another day goes by. Mr. Hale is engineer-in-chief of the road. The road will be about 124 miles in length, the following being the distances: Ottawa to High Falls, 32 miles; High Falls to Coteau Landing, 47 miles; southern section, 45 miles. The grades are very light, not exceeding 30 feet to the mile at any part, and the greatest curve only three degrees. The engineers say it is one of the finest routes for a railway that could be selected between Ottawa and Coteau. There is only one bridge of any size, and that is the one over the Nation at High Falls; work on which has already been begun. It is expected that trains will be running on the line between the Coteau and the city by the 1st of Sept. next.

A remarkable feat of railroad building has recently been undertaken from Portland to Dallas, Oregon. The road will be eighty-six miles long, and the estimated cost is $3,000,000. Much of the roadway must be blasted in the flinty face of lofty precipices, or drilled through no less unyielding rock, and every foot is a struggle with nature. About ten miles below Dallas is a bluff of basaltic rock, rising 300 ft. from the Columbia River, along whose side the road is to pass. Men suspended by ropes 150 ft. over this wall drill and blast the solid rock, their work being attended with the greatest danger. The largest blast on the line thus far has been at a point ten miles above the cascades, a mass of rock 165 ft. high, 170 wide and 70 ft. thick at the base, containing more than 40,000 cubic yards, being removed by the explosion of 10,000 lbs. of Judson's powder, equal in force to 20,000 of black. Three tunnels, from 300 to 550 ft. long are being drilled, steam or compressed air being used in the work. At two points a new and phenomenal difficulty is encountered, the mountain settling or sliding into the river at the rate of about 12 in. a year, and the trouble will not cease with the finishing of the road.

The Cincinnati Southern Railroad Co. has been organized under the name of the "Cincinnati, New Orleans & Pacific Railway Co.;" on Saturday last the entire stock was subscribed for; 49 per cent. is held in Cincinnati, and the balance of 51 per cent. is held by the Alabama and Louisiana, Texas Pacific Railway Junction Co. (limited) as the syndicate representing the Erlanger system of railroads in the South is called. The Cincinnati *Commercial* says: There was considerable ungratified pressure for stock, and offers of three and four per cent. premium were refused, it being generally understood that the investment was worth from seven to ten per cent. At the close of the subscription the following directors were chosen, the usual thirty days' delay being unanimously waived, and but one ticket being presented: Frederick Wolffe, Montgomery, Ala.; Charles A. Page, New York City; John Scott, Chattanooga, Tenn.; Theodore Cook, Cincinnati; Alex. McDonald, Cincinnati; Wm. A. Goodman, Cincinnati; Edgar M. Johnson, Cincinnati. The directors then withdrew and organized by electing the following officers: President, Theodore Cook; Vice-President and General Manager, John Scott; Secretary, George F. Doughty; Treasurer, H. H. Tatem; General Counsel, Edgar M. Johnson; Executive Committee, Theodore Cook, John Scott and Edgar M. Johnson.

THE CONTINENTAL RAILWAY.—The history of the Continental Railway, which is now under construction in several States at the same time, may be said to date back to the time when Henry Clay proposed his straight road from New York to the West. That was before railroads were seriously thought of. Robert J. Walker first proposed a straight steam road, such as the Continental Railroad will be when finished, and in 1855 the charter for the company was obtained from Pennsylvania by Governor Bigelow, Thomas H. Bannock, General John W. Geary and others. The Pennsylvania charter covered, however, only the State of Pennsylvania, and the work of making surveys over the twelve hundred miles between New York and Council Bluffs and delays in obtaining charters postponed the work through many years, so that it was only in 1873 that actual work was begun. The panic of that year stopped all railroad building. In 1878 the road was reorganized with a capital of one hundred millions of dollars, the European stockholders getting control. Active work was then begun in earnest, and it has since been continued. The whole road has been surveyed three times, and five or six hundred miles of grading have been done at different points along the line. Work is now going on upon the bridges to be built and upon the preliminary work for the six tunnels in the Alleghany Mountains, the longest of which is two miles in length, and the shortest half a mile. Some three millions of dollars have already been spent by the company. The road will start from a point on the New Jersey shore south of the terminus of the New Jersey Central Railroad, the charter of the Continental Railway giving it the right to fill in and occupy some twenty acres of land under water at that point, the depth at low water not being more than three feet—too shallow for any kind of navigation. The New Jersey Central Railroad has obtained an injunction restraining such work of filling up, upon the ground that its water front will be injured, and the work of driving piles is now stopped while the matter is argued in the courts. On the New York side of the North River the Continental Railway Company has offered to lease from the city the water front from Pier 1 to Pier 13, agreeing to build a splendid line of ten piers, each eight hundred feet long and one hundred feet wide, upon this front of two thousand feet, the piers and superstructures to be built after designs approved by the Dock Department. The company proposes to put the piers upon wrought-iron piles five feet in diameter filled in with concrete. The Third avenue bridge over the Harlem River is built in that way, and shows only one-eighth of an inch depression after twelve years' use. The company also agrees to make West street, along its line, two hundred and fifty feet wide. After leaving Jersey City, the line of the Continental Railway runs through Newark, Belvidere, Mauch Chunk, where a piece of the "chunk," or mountain, will have to be shaved off; Bloomsburgh, Milton, where the tracks will cross those of the Philadelphia & Reading road; Lockhaven, Clearfield, Brady's Bend, Newcastle, Akron, New London, Tiffin, Leipsic, Fort Wayne and Rensselaer, where a branch 70 miles long will run north to Chicago, and another branch 222 miles long will run south to St. Louis. The main road will continue through Rock Island, where it will cross on the government bridge, Muscatine and Council Bluffs, where it will connect with the Union Pacific. Along this route there is no grade exceeding 40 ft. to a mile, and from Rensselaer the country is almost flat. Engines burning bituminous coal will be used from there to Council Bluffs. The rails to be used are now making in a rolling-mill leased for the purpose, the intention being to make them better for heavy freight trains than any yet laid. Unless some obstacles intervene the road will be finished, according to the statements of its officers, some time in 1883. Any one who takes a map will see that it gives a perfectly straight line from New York to Council Bluffs, and that its line to Chicago is shorter by a hundred miles than any other route. The officers of the company are J. T. Snead, president; W. H. Smith, vice-president; William Thorpe, secretary; and Samuel McElroy, chief-engineer.